



# NASA TECH BRIEF



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## Large Capacitor Performs as a Distributed Parameter Pulse Line

### The problem:

In the development of a pulsed plasma accelerator for space propulsion application, a capacitor bank consisting of a number of capacitors in parallel has been used as the energy storage element. Current from this source is pulsed directly through the plasma between the electrodes of the system. For certain applications a constant current lasting for a specified period of time is desirable. Independent control over absolute magnitude of the current and current pulse duration may also be desirable.

### The solution:

Capacitors of extended foil construction having single unit capacitance as great as 180 microfarads, with self inductance of approximately  $10^{-9}$  henries, and capable of handling operating voltages greater than 10 kv. In operation these capacitors perform as a distributed parameter pulse line in which current, amplitude, and period are readily controlled.

### How it's done:

The capacitor is made essentially the same as the conventional extended foil construction, but with particular care being taken to avoid parasitic inductance in the connections. What is of importance here is that the transit time of the electromagnetic wave is longer than the capacitor charge-discharge time as determined by actual discharge conditions. The capacitor electromagnetic wave that is discharging the

foils propagates radially, the direction of propagation being determined by the location of the return current strap. A set of equations is derived to calculate the values of the distributed parameters (inductance, capacitance, impedance, and pulse time). The calculated values of line impedance and pulse time are in close agreement with experimentally measured values.

### Notes:

1. In this type capacitor, the output waveform may be tailored to obtain more efficient capacitor energy transfer to the load.
2. This design should be of interest to manufacturers of energy storage systems and magnetic field devices.
3. Inquiries concerning this innovation may be directed to:

Technology Utilization Officer  
Lewis Research Center  
21000 Brookpark Road  
Cleveland, Ohio 44135  
Reference: B66-10291

### Patent status:

No patent action is contemplated by NASA.

Source: Terence J. Gooding et al  
of General Dynamics/Astronautics  
under contract to  
Lewis Research Center  
(Lewis-176)

Category 01